2013 Voyageurs National Park Moose Population Survey Report

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Background

Voyageurs National Park (Minnesota) was established in 1975 in part to fulfill the National Park Service's mission to preserve and protect wildlife populations and provide opportunities for the public to enjoy them. Moose are native to Voyageurs National Park (VNP) but recent declines in other moose populations in the region raised concerns about the long-term viability of moose in the park. Moose populations in northwestern Minnesota declined precipitously during the period 1984-2000 (Murray et al. 2006). Moose populations in northeastern Minnesota have been experiencing similar declines in recent years, with the 2013 estimate more than 68% lower than estimates in 2006 (DelGuidice 2013). Voyageurs National Park is not surveyed as part of the state's systematic annual survey because it lies just outside of primary moose range in northeastern Minnesota (Fig. 1; DelGuidice 2013). Voyageurs National Park, in collaboration with the University of Minnesota-Duluth and the US Geological Survey, began more intensive monitoring and research of moose in and adjacent to the park in 2009 to better understand local moose population dynamics. Information will help NPS managers to determine how to ensure the survival of moose for future generations.

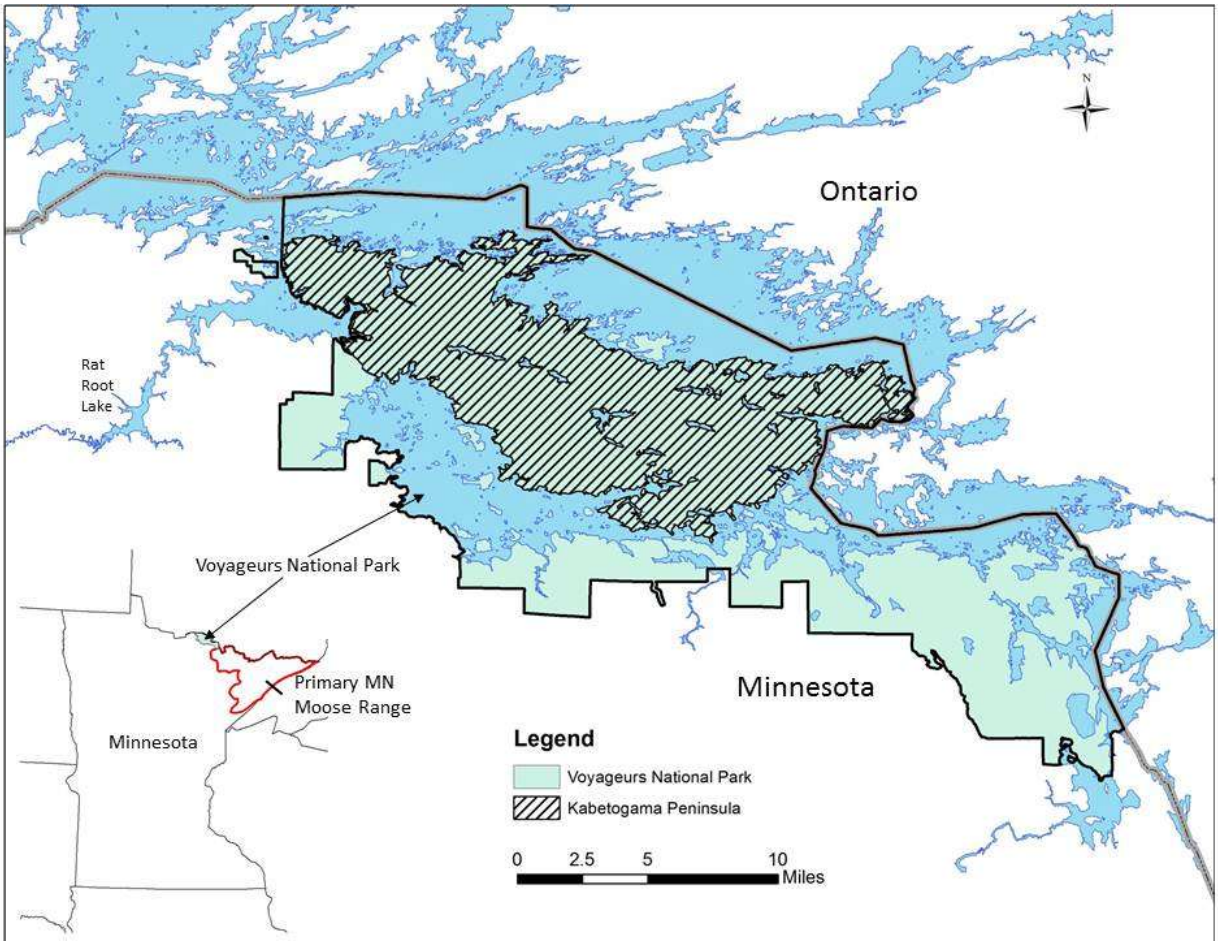
Methods

We surveyed the moose population within the boundaries of Voyageurs National Park during Feb. 20-28, 2013. The survey area was limited to the Kabetogama Peninsula, a 305 km^2 roadless area in the center of the park where >95% of the Park's moose population occurs (Figure 1). Surveys were conducted using a 2-seat Husky Aviat during which the pilot and observer search for moose while the plane flies overlapping circles at an intensity of at least 3.5 min/km^2. The peninsula was broken down into 23 separate survey units to facilitate the completion of the survey, but all units were surveyed. For each observed moose we recorded location, group size, sex/age class (calf, yearling, adult cow, adult bull), and whether the animal was standing or bedded. We also recorded all observations of white-tailed deer and gray wolves.

We conducted 23 test plots to estimate visibility (detection probability) of moose for our survey method. We searched test plots, using the same flight pattern and intensity as the survey plots, for moose wearing GPS telemetry collars. Locations of moose not observed during the test plots were confirmed by GPS locations or using VHF telemetry. Test plots were completed during Feb. 1-Mar. 26, 2013.

The number of moose observed during the aerial survey was adjusted with the estimated detection probability, giving a population estimate for the Kabetogama Peninsula (± 90% Confidence Intervals). We also estimated other measures of population status, including calf:cow ratio, twinning rates, and bull:cow ratio. We estimated pregnancy rates (percent of adult females that were pregnant via blood progesterone levels) in mid-winter during aerial capture operations for GPS collaring events.

Figure 1. 2013 moose survey area in Voyageurs National Park, Minnesota, USA. The Kabetogama Peninsula (305 km^2) contains >95% of the Park's moose population. A small pocket of moose (approx. 10-15 individuals) also exists west of the park in the Rat Root Lake area, and evidence from GPS collars suggests that some moose seasonally move between this area and the Kabetogama Peninsula.



Results

Survey conditions were considered "good" to "excellent" during the 2013 survey (including visibility trials), with snow depths exceeding 60-90 cm (24-36") throughout the Kabetogama Peninsula and little snow in the canopies of trees. We detected 78% (±6%; 25 out of 32) of collared moose during visibility trials.

We counted 36 moose during the survey (9 bulls, 16 cows, 2 yearlings, and 9 calves). After correcting for visibility, the 2013 population estimate for the Kabetogama Peninsula was 46 moose (90% Confidence Interval = 43-50), or 0.15 moose/km^2. We accounted for an additional 5 moose (2 cows, 1 yearling, and 2 calves) that were not observed during the survey but were known to occur on the Kabetogama Peninsula during the survey period from GPS collars and incidental observations. Therefore the minimum number of moose on the Kabetogama Peninsula during the 2013 survey was 41, very close to the lower end of the 90% Confidence Interval for the survey estimate. The 2013 population estimate

is similar to those from the period 2009-2011 (Table 1). Indices of calf production in 2013 were relatively high. The estimated calf:cow ratio was 0.61 and calves were 25% of the population. The bull:cow ratio was relatively low (0.56), similar to estimates from 2010-2011. Pregnancy rate (N=8 cows) was also relatively low (63%).

Table 1. Population estimates and demographic characteristics for moose in the Kabetogama Peninsula, Voyageurs National Park, USA, derived from aerial surveys and other sources from 1991-2013.

Year	Population Estimate	90% Confidence Interval for Estimate	Calves: Cow	% Calves	% Twins[a]	Bulls: Cow	% Pregnant[b]
1991	31	23-57	-	9	-	-	-
1992	47	35-72	-	9	-	-	-
1997	53	32-88	-	25	~10[c]	-	-
1998	38	23-63	-	9	0	-	-
2009	51	44-58	-	7	0	-	-
2010	41	36-47	0.54	23	0	0.82	60
2011	45	39-51	0.60	28	8	0.53	69
2012	----------Not Surveyed----------						33
2013	46	43-50	0.61	25	6	0.56	63

[a]Percentage of twins observed among all cows

[b]Estimated from blood samples collected during winter capture for GPS collaring

[c]One set of twins recorded; % Twins for 1997 based on assumption of 1:1 adult sex ratio

Discussion

Survey results from 2013, when combined with earlier survey results from 2009-2011 and other available data, suggest Voyageurs National Park currently maintains a stable, low density moose population. The northeastern Minnesota moose population declined 65% from 2009-2013 (DelGuidice 2013). Assuming a similar decline was occurring in VNP, the expected 2013 population estimate in VNP should have been 18 moose. To the contrary, we documented a minimum of 41 moose currently living in the Kabetogama Peninsula. We believe the observed stability in the VNP population during the present study is further corroborated by estimates of adult survival obtained from telemetry/GPS collars and estimates of calf recruitment obtained from aerial surveys. Since 2010, we have monitored survival

of >25-40% of the estimated adult population with GPS telemetry collars. Six of 22 adult moose collared since 2010 in VNP have died, resulting in a mean annual mortality rate of approximately 10%. Two of the moose in the VNP study died from health-related issues, 3 from unknown causes (either health-related or predation), and 1 was assumed to be capture-related. Albeit from a small sample size, our estimate of annual adult mortality is similar to those reported for non-hunting mortality rates from other moose populations in North America but noticeably less than those reported for the northwestern Minnesota population in 1995-2000 (21%; Murray et al. 2006) and for the northeastern Minnesota population in 2002-2008 (19%; Lenarz et al. 2009).

Two indices of productivity (i.e., calf:cow ratio and percent calves) estimated from 2010-2013 surveys were relatively high for moose in the region. When considered in relation to the low pregnancy rates we observed, recent calf:cow ratios suggest that those cows that do give birth have a relatively high chance to have their calf survive to mid-winter. Though data are lacking about actual recruitment of calves into the adult population at VNP, the recent survey data do suggest that it may be enough to offset the observed adult mortality, and therefore maintain a stable population. However, gray wolves and black bears, both of which are abundant in Voyageurs, readily prey on young calves and annual survival of calves in most moose populations is low. Densities of white-tailed deer are relatively high in the VNP area (~10 deer/mi^2) and it's possible that wolves and other potential predators more readily prey on deer rather than moose. More study is needed to better understand calf survival and recruitment in the VNP area in relation to other populations in the region.

Pregnancy rates in most North American moose populations typically exceed 80-90%. The low pregnancy rates observed in VNP since 2010 could be indicative of poor condition or health-related issues in the population. They also may be reflective of the low bull:cow ratio, i.e., there may not be enough bulls available to breed all cows in the population. We acknowledge that we do not fully understand what factors may be contributing to the low bull:cow ratios observed, since this result runs counter to expectations for an unhunted population. Moose hunting is not allowed in VNP, and the area west of the park has also been closed to hunting since 1923.

It is not clear why the moose population in VNP appears relatively stable when nearby populations are declining. Spatial variability in population trends and demographic patterns likely exist in most populations if examined at a large enough scale. In other words, the stable population apparent in VNP may not be unique in the region. Current estimates are similar to those reported in 1997-1998 (Voyageurs National Park, unpublished data) and 1991-1992 (Gogan et al. 1989). Though survey methods have changed slightly over the span 1991-2013, it is likely that VNP has maintained a low density population throughout this period. However, in spite of the apparent current population stability, the potential effects of large-scale impacts such as climate warming or disease outbreaks threaten the long-term persistence of the small, isolated moose population in VNP.

The method we employed in 2013, where we flew overlapping circles at a higher search intensity, appears to be effective for surveying moose at the low density that occurs in VNP. We will continue to refine the method for future surveys, particularly in estimating visibility in different years under variable conditions. In addition to population monitoring, Voyageurs National Park is currently investigating

other aspects of moose ecology in collaboration with the University of Minnesota-Duluth, Lakehead University, and the USGS. Other studies include understanding how moose behave in response to high temperatures and other weather events, how and why moose use wetlands for foraging and temperature regulation, and the interactions of moose, deer, beavers, and wolves.

Acknowledgements

Special thanks go to Voyageurs National Park employees Steve Mazur (pilot) and Bryce Olson (biological science technician) for data collection for the 2013 survey. Ron Moen, University of Minnesota-Duluth, is a co-investigator for the ongoing moose research in VNP, including the capture and collaring of moose in the park since 2010. John Guidice and John Fieberg, Minnesota Department of Natural Resources, provided helpful advice on 2013 aerial survey design. The Minnesota Department of Natural Resources and the Minnesota Zoo have provided assistance with capture and handling of moose during collaring events. We also appreciate the support of the Minnesota Department of Natural Resources Wildlife Health Program for analyzing biological samples collected from live-capture moose (including pregnancy tests) and the University of Minnesota Veterinary Diagnostic Lab for performing necropsies on dead moose.

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